

SEQUENCE LISTING

<110> Thompson, Mark
Knuth, Mark
Cardineau, Guy

<120> Bacillus thuringiensis Toxins with Improved Activity

<130> MA-702D2

<150> US 09/222,594

<151> 1998-12-28

<150> US 08/904,278

<151> 1998-07-31

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<170> PatentIn version 3.1

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<211> 1425

<212> DNA

<213> Bacillus thuringiensis

<400> 1

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 <213> Bacillus thuringiensis

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Ala Tyr Ile Gln Thr Gly Leu Gly Leu Pro Val Asn Glu Gln Gln Leu
 50 55 60

Arg Thr His Val Asn Leu Ser Gln Asp Ile Ser Ile Pro Ser Asp Phe
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Ser Gln Leu Tyr Asp Val Tyr Cys Ser Asp Lys Thr Ser Ala Glu Trp
 85 90 95

Trp Asn Lys Asn Leu Tyr Pro Leu Ile Ile Lys Ser Ala Asn Asp Ile
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Ala Ser Tyr Gly Phe Lys Val Ala Gly Asp Pro Ser Ile Lys Lys Asp
 115 120 125

Gly Tyr Phe Lys Lys Leu Gln Asp Glu Leu Asp Asn Ile Val Asp Asn
 130 135 140

Asn Ser Asp Asp Asp Ala Ile Ala Lys Ala Ile Lys Asp Phe Lys Ala
 145 150 155 160

Arg Cys Gly Ile Leu Ile Lys Glu Ala Lys Gln Tyr Glu Glu Ala Ala
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Lys Asn Ile Val Thr Ser Leu Asp Gln Phe Leu His Gly Asp Gln Lys
 180 185 190

Lys Leu Glu Gly Val Ile Asn Ile Gln Lys Arg Leu Lys Glu Val Gln
 195 200 205

Thr Ala Leu Asn Gln Ala His Gly Glu Ser Ser Pro Ala His Lys Glu
 210 215 220

Leu Leu Glu Lys Val Lys Asn Leu Lys Thr Thr Leu Glu Arg Thr Ile
 225 230 235 240

Lys Ala Glu Gln Asp Leu Glu Lys Lys Val Glu Tyr Ser Phe Leu Leu
 245 250 255

Gly Pro Leu Leu Gly Phe Val Val Tyr Glu Ile Leu Glu Asn Thr Ala
 260 265 270

Val Gln His Ile Lys Asn Gln Ile Asp Glu Ile Lys Lys Gln Leu Asp
 275 280 285

Ser Ala Gln His Asp Leu Asp Arg Asp Val Lys Ile Ile Gly Met Leu
 290 295 300

Asn Ser Ile Asn Thr Asp Ile Asp Asn Leu Tyr Ser Gln Gly Gln Glu
 305 310 315 320

Ala Ile Lys Val Phe Gln Lys Leu Gln Gly Ile Trp Ala Thr Ile Gly
 325 330 335

Ala Gln Ile Glu Asn Leu Arg Thr Thr Ser Leu Gln Glu Val Gln Asp
 340 345 350

Ser Asp Asp Ala Asp Glu Ile Gln Ile Glu Leu Glu Asp Ala Ser Asp
355 360 365

Ala Trp Leu Val Val Ala Gln Glu Ala (Arg) Asp Phe Thr Leu Asn Ala
370 375 380

Tyr Ser Thr Asn Ser (Arg) Gln Asn Leu Pro Ile Asn Val Ile Ser Asp
385 390 395 400

Ser Cys Asn Cys Ser Thr Thr Asn Met Thr Ser Asn Gln Tyr Ser Asn
405 410 415

Pro Thr Thr Asn Met Thr Ser Asn Gln Tyr Met Ile Ser His Glu Tyr
420 425 430

Thr Ser Leu Pro Asn Asn Phe Met Leu Ser (Arg) Asn Ser Asn Leu Glu
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Tyr Lys Cys Pro Glu Asn Asn Phe Met Ile Tyr Trp Tyr Asn Asn Ser
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<213> Bacillus thuringiensis

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Asn Gly Asn Gln Phe Ile Ile Ser Lys Gln Glu Trp Ala Thr Ile Gly
 35 40 45

Ala Tyr Ile Gln Thr Gly Leu Gly Leu Pro Val Asn Glu Gln Gln Leu
 50 55 60

Arg Thr His Val Asn Leu Ser Gln Asp Ile Ser Ile Pro Ser Asp Phe
 65 70 75 80

Ser Gln Leu Tyr Asp Val Tyr Cys Ser Asp Lys Thr Ser Ala Glu Trp
 85 90 95

Trp Asn Lys Asn Leu Tyr Pro Leu Ile Ile Lys Ser Ala Asn Asp Ile
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Ala Ser Tyr Gly Phe Lys Val Ala Gly Asp Pro Ser Ile Lys Lys Asp
 115 120 125

Gly Tyr Phe Lys Lys Leu Gln Asp Glu Leu Asp Asn Ile Val Asp Asn
 130 135 140

Asn Ser Asp Asp Asp Ala Ile Ala Lys Ala Ile Lys Asp Phe Lys Ala
 145 150 155 160

Arg Cys Gly Ile Leu Ile Lys Glu Ala Lys Gln Tyr Glu Glu Ala Ala
 165 170 175

Lys Asn Ile Val Thr Ser Leu Asp Gln Phe Leu His Gly Asp Gln Lys
 180 185 190

Lys Leu Glu Gly Val Ile Asn Ile Gln Lys Arg Leu Lys Glu Val Gln
 195 200 205

Thr Ala Leu Asn Gln Ala His Gly Glu Ser Ser Pro Ala His Lys Glu
 210 215 220

Leu Leu Glu Lys Val Lys Asn Leu Lys Thr Thr Leu Glu Arg Thr Ile
 225 230 235 240

Lys Ala Glu Gln Asp Leu Glu Lys Lys Val Glu Tyr Ser Phe Leu Leu
 245 250 255

Gly Pro Leu Leu Gly Phe Val Val Tyr Glu Ile Leu Glu Asn Thr Ala
 260 265 270

Val Gln His Ile Lys Asn Gln Ile Asp Glu Ile Lys Lys Gln Leu Asp
 275 280 285

Ser Ala Gln His Asp Leu Asp Arg Asp Val Lys Ile Ile Gly Met Leu
 290 295 300

Asn Ser Ile Asn Thr Asp Ile Asp Asn Leu Tyr Ser Gln Gly Gln Glu
305 310 315 320

Ala Ile Lys Val Phe Gln Lys Leu Gln Gly Ile Trp Ala Thr Ile Gly
325 330 335

Ala Gln Ile Glu Asn Leu Arg Thr Thr Ser Leu Gln Glu Val Gln Asp
340 345 350

Ser Asp Asp Ala Asp Glu Ile Gln Ile Glu Leu Glu Asp Ala Ser Asp
355 360 365

Ala Trp Leu Val Val Ala Gln Glu Ala Arg Asp Phe Thr Leu Asn Ala
370 375 380

Tyr Ser Thr Asn Ser Arg Gln Asn Leu Pro Ile Asn Val Ile Ser Asp
385 390 395 400

Ser Cys Asn Cys Ser Thr Thr Asn Met Thr Ser Asn Gln Tyr Ser Asn
405 410 415

Pro Thr Thr Asn Met Thr Ser Asn Gln Tyr Met Ile Ser His Glu Tyr
420 425 430

Thr Ser Leu Pro Asn Asn Phe Met Leu Ser Arg Asn Ser Asn Leu Glu
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Tyr Lys Cys Pro Glu Asn Asn Phe Met Ile Tyr Trp Tyr Asn Asn Ser
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Asp Trp Tyr Asn Asn Ser Asp Trp Tyr Asn Asn
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Trp Ala Thr Ile Gly Ala Tyr Ile Gln Thr Gly Leu Gly Leu Pro Val
 35 40 45

Asn Glu Gln Gln Leu Arg Thr His Val Asn Leu Ser Gln Asp Ile Ser
50 55 60

Ile Pro Ser Asp Phe Ser Gln Leu Tyr Asp Val Tyr Cys Ser Asp Lys
65 70 75 80

Thr Ser Ala Glu Trp Trp Asn Lys Asn Leu Tyr Pro Leu Ile Ile Lys
85 90 95

Ser Ala Asn Asp Ile Ala Ser Tyr Gly Phe Lys Val Ala Gly Asp Pro
100 105 110

Ser Ile Lys Lys Asp Gly Tyr Phe Lys Lys Leu Gln Asp Glu Leu Asp
115 120 125

Asn Ile Val Asp Asn Asn Ser Asp Asp Asp Ala Ile Ala Lys Ala Ile
130 135 140

Lys Asp Phe Lys Ala Arg Cys Gly Ile Leu Ile Lys Glu Ala Lys Gln
145 150 155 160

Tyr Glu Glu Ala Ala Lys Asn Ile Val Thr Ser Leu Asp Gln Phe Leu
165 170 175

His Gly Asp Gln Lys Lys Leu Glu Gly Val Ile Asn Ile Gln Lys Arg
180 185 190

Leu Lys Glu Val Gln Thr Ala Leu Asn Gln Ala His Gly Glu Ser Ser
195 200 205

Pro Ala His Lys Glu Leu Leu Glu Lys Val Lys Asn Leu Lys Thr Thr
210 215 220

Leu Glu Arg Thr Ile Lys Ala Glu Gln Asp Leu Glu Lys Lys Val Glu
225 230 235 240

Tyr Ser Phe Leu Leu Gly Pro Leu Leu Gly Phe Val Val Tyr Glu Ile
245 250 255

Leu Glu Asn Thr Ala Val Gln His Ile Lys Asn Gln Ile Asp Glu Ile
260 265 270

Lys Lys Gln Leu Asp Ser Ala Gln His Asp Leu Asp Arg Asp Val Lys
 275 280 285

Ile Ile Gly Met Leu Asn Ser Ile Asn Thr Asp Ile Asp Asn Leu Tyr
 290 295 300

Ser Gln Gly Gln Glu Ala Ile Lys Val Phe Gln Lys Leu Gln Gly Ile
 305 310 315 320

Trp Ala Thr Ile Gly Ala Gln Ile Glu Asn Leu Arg Thr Thr Ser Leu
 325 330 335

Gln Glu Val Gln Asp Ser Asp Asp Ala Asp Glu Ile Gln Ile Glu Leu
 340 345 350

Glu Asp Ala Ser Asp Ala Trp Leu Val Val Ala Gln Glu Ala Arg Asp
 355 360 365

Phe Thr Leu Asn Ala Tyr Ser Thr Asn Ser Arg Gln Asn Leu Pro Ile
 370 375 380

Asn Val Ile Ser Asp Ser Cys Asn Cys Ser Thr Thr Asn Met Thr Ser
 385 390 395 400

Asn Gln Tyr Ser Asn Pro Thr Thr Asn Met Thr Ser Asn Gln Tyr Met
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<210> 7

<211> 1140

<212> DNA

<213> *Bacillus thuringiensis*

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<211> 380

<212> PRT

<213> *Bacillus thuringiensis*

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Trp Ala Thr Ile Gly Ala Tyr Ile Gln Thr Gly Leu Gly Leu Pro Val
35 40 45

Asn Glu Gln Gln Leu Arg Thr His Val Asn Leu Ser Gln Asp Ile Ser
50 55 60

Ile Pro Ser Asp Phe Ser Gln Leu Tyr Asp Val Tyr Cys Ser Asp Lys
65 70 75 80

Thr Ser Ala Glu Trp Trp Asn Lys Asn Leu Tyr Pro Leu Ile Ile Lys
85 90 95

Ser Ala Asn Asp Ile Ala Ser Tyr Gly Phe Lys Val Ala Gly Asp Pro
 100 105 110

Ser Ile Lys Lys Asp Gly Tyr Phe Lys Lys Leu Gln Asp Glu Leu Asp
 115 120 125

Asn Ile Val Asp Asn Asn Ser Asp Asp Asp Ala Ile Ala Lys Ala Ile
 130 135 140

Lys Asp Phe Lys Ala Arg Cys Gly Ile Leu Ile Lys Glu Ala Lys Gln
 145 150 155 160

Tyr Glu Glu Ala Ala Lys Asn Ile Val Thr Ser Leu Asp Gln Phe Leu
 165 170 175

His Gly Asp Gln Lys Lys Leu Glu Gly Val Ile Asn Ile Gln Lys Arg
 180 185 190

Leu Lys Glu Val Gln Thr Ala Leu Asn Gln Ala His Gly Glu Ser Ser
 195 200 205

Pro Ala His Lys Glu Leu Leu Glu Lys Val Lys Asn Leu Lys Thr Thr
 210 215 220

Leu Glu Arg Thr Ile Lys Ala Glu Gln Asp Leu Glu Lys Lys Val Glu
 225 230 235 240

Tyr Ser Phe Leu Leu Gly Pro Leu Leu Gly Phe Val Val Tyr Glu Ile
 245 250 255

Leu Glu Asn Thr Ala Val Gln His Ile Lys Asn Gln Ile Asp Glu Ile
 260 265 270

Lys Lys Gln Leu Asp Ser Ala Gln His Asp Leu Asp Arg Asp Val Lys
 275 280 285

Ile Ile Gly Met Leu Asn Ser Ile Asn Thr Asp Ile Asp Asn Leu Tyr
 290 295 300

Ser Gln Gly Gln Glu Ala Ile Lys Val Phe Gln Lys Leu Gln Gly Ile
 305 310 315 320

Trp Ala Thr Ile Gly Ala Gln Ile Glu Asn Leu Arg Thr Thr Ser Leu
 325 330 335

Gln Glu Val Gln Asp Ser Asp Asp Ala Asp Glu Ile Gln Ile Glu Leu
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Glu Asp Ala Ser Asp Ala Trp Leu Val Val Ala Gln Glu Ala Arg Asp
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<211> 1185

<212> DNA

<213> *Bacillus thuringiensis*

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 <213> *Bacillus thuringiensis*

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 20 25 30

Gly Pro Glu Gly Met Val Thr Lys Asp Gly Phe Ile Ile Ser Lys Glu
 35 40 45

Glu Trp Ala Phe Val Gln Ala Tyr Val Thr Thr Gly Thr Gly Leu Pro
 50 55 60

Ile Asn Asp Asp Glu Met Arg Arg His Val Gly Leu Pro Ser Arg Ile
 65 70 75 80

Gln Ile Pro Asp Asp Phe Asn Gln Leu Tyr Lys Val Tyr Asn Glu Asp
 85 90 95

Lys His Leu Cys Ser Trp Trp Asn Gly Phe Leu Phe Pro Leu Val Leu
 100 105 110

Lys Thr Ala Asn Asp Ile Ser Ala Tyr Gly Phe Lys Cys Ala Gly Lys
 115 120 125

Gly Ala Thr Lys Gly Tyr Tyr Glu Val Met Gln Asp Asp Val Glu Asn
 130 135 140

Ile Ser Asp Asn Gly Tyr Asp Lys Val Ala Gln Glu Lys Ala His Lys
 145 150 155 160

Asp Leu Gln Ala Arg Cys Lys Ile Leu Ile Lys Glu Ala Asp Gln Tyr
 165 170 175

Lys Ala Ala Ala Asp Asp Val Ser Lys His Leu Asn Thr Phe Leu Lys
180 185 190

Gly Gly Gln Asp Ser Asp Gly Asn Asp Val Ile Gly Val Glu Ala Val
195 200 205